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PESTS NOT KNOWN TO OCCUR IN THE UNITED STATES OR OF LIMITED
DISTRIBUTION, NO. 70: A CEREAL CYST NEMATODE

APHIS-PPQ

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APHIS 81-46
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Pest

Heterodera hordecalis Andersson

Synonym

Bidera hordecalis (Andersson) Krall and Krall

Order: Family

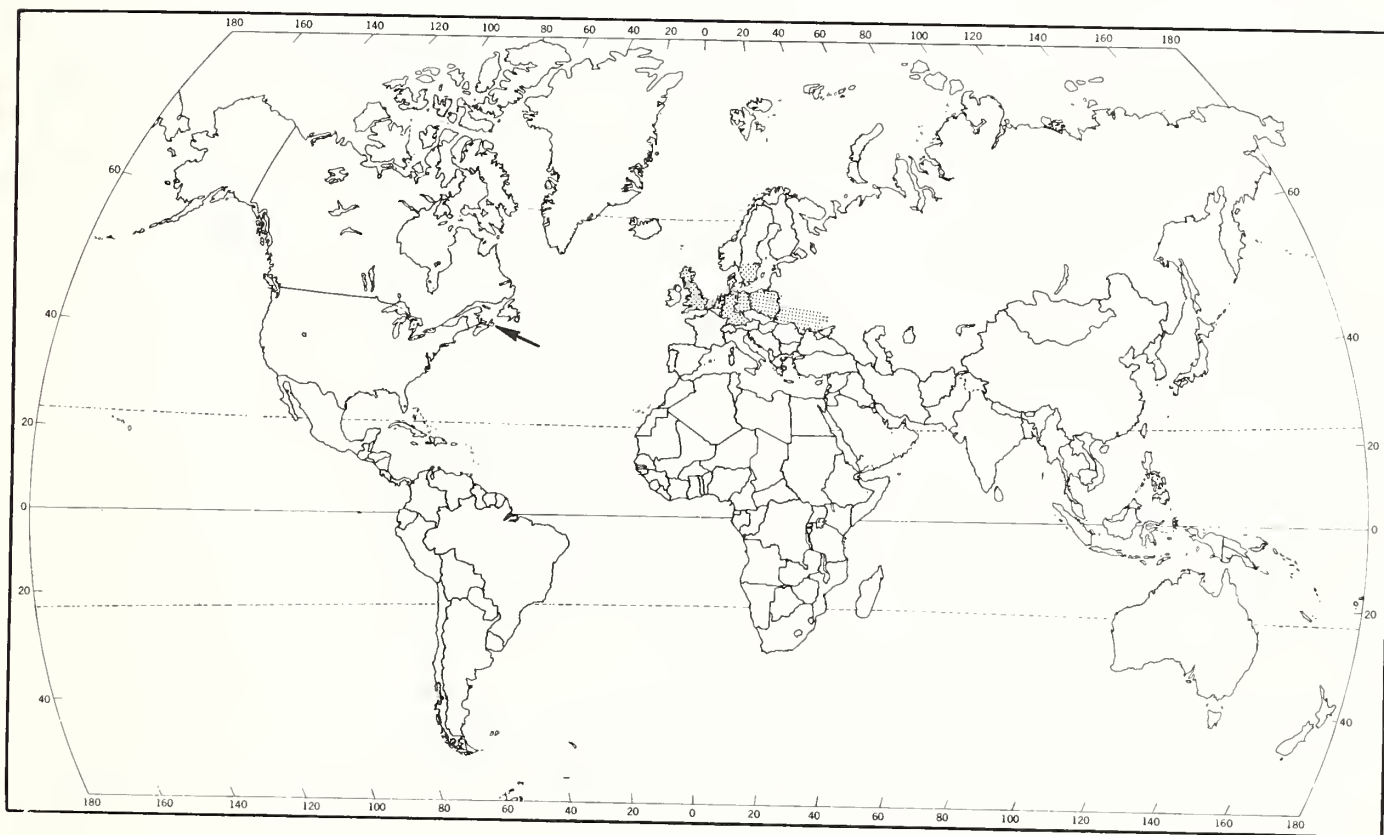
Tylenchida: Heteroderidae

Economic
Importance

Some barley fields are severely damaged in Sweden. Damage to
oats, spring rye, and most spring wheat appears to be slight.
H. hordecalis is less pathogenic than H. avenae, except on
barley (Andersson 1976).

General
Distribution

Canada (Prince Edward Island), Denmark, East Germany,
Netherlands, Poland, Soviet Union (Ukraine), Sweden,
United Kingdom (England, Scotland, Wales), and West Germany



Heterodera hordecalis distribution map (Prepared by
Non-Regional Administrative Operations Office and Biological
Assessment Support Staff, PPQ, APHIS, USDA).

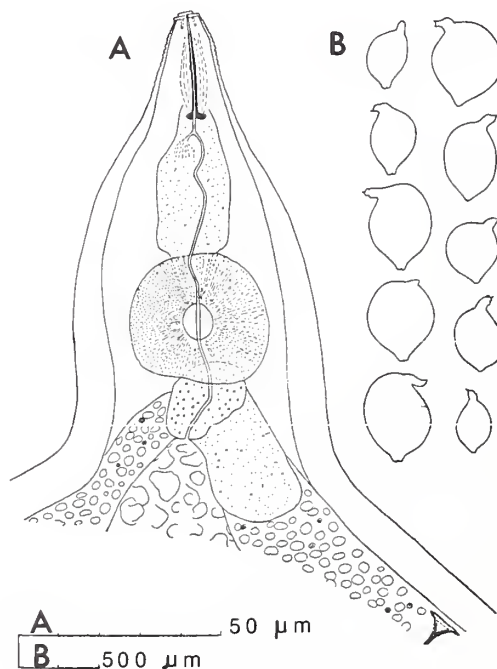
(Andersson 1975, Baksik et al. 1978, Dowe and Decker 1984, Maas 1976, Nikitin 1979, Sturhan 1976). Andersson (pers. comm.) believes Mulvey's (1972) report of H. latipons in Prince Edward Island is likely H. hordecalis.

Hosts

Agrostis stolonifera, Ammophila arenaria (marram grass, European beachgrass), Avena sativa (oat), Bromus arvensis (field brome), B. inermis (smooth brome), Dactylis glomerata (orchardgrass), Elymus arenarius (sea lyme grass), Festuca pratensis (meadow fescue), F. rubra (red fescue), Hordeum vulgare (barley), Lolium multiflorum (Italian ryegrass), L. perenne (perennial ryegrass), Phleum pratense (timothy), Poa pratensis (Kentucky bluegrass), Puccinellia maritima, Secale cereale (rye), and Triticum aestivum (wheat).

Barley and rye are the best hosts. Nematode populations react differently to oats as a host although none reproduced readily on it. Most wheat cultivars tested were poor hosts. Most grasses are poor hosts but probably help maintain populations between better cereal hosts (Andersson 1976).

(Fig. 1)



Heterodera hordecalis female. A. Esophageal region. Excretory pore at bottom of figure on right. B. Entire. Left row, lateral view; right, dorso-ventral view (From Nematologica, courtesy E. J. Brill).

Characters

Data (measurements in micrometers) from Andersson (1975).

FEMALES - Neck length = 107 (76-136), stylet length = 27.3 (25.5-30), opening of dorsal esophageal gland from stylet base = 5.1 (3.5-8), anus to vulva = 53.1 (40-60), midbody cuticle thickness = 9.3 (5.5-15).

Female body ovoid with small but distinct terminal vulval cone. Neck well defined, usually inclined to long axis of body (Fig. 1). Body measurements about the same as for cysts. Esophagus typical of genus. Subcrystalline layer present, easily detached. Small egg sac infrequently present, without eggs.

CYSTS

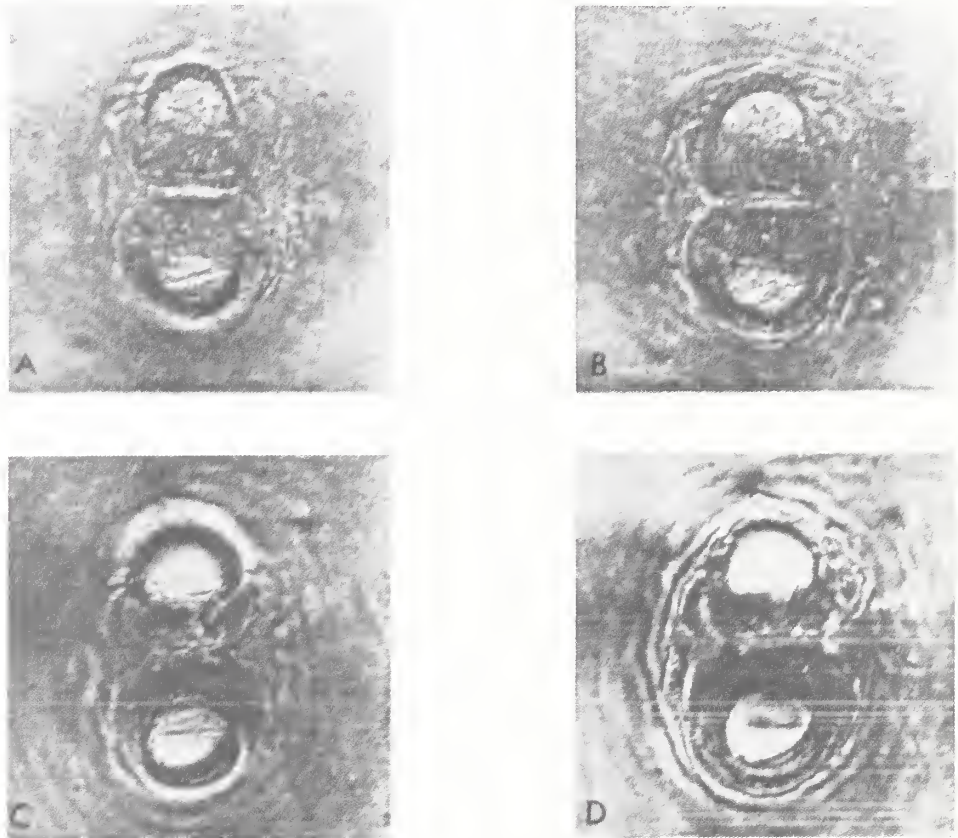
Measurements of two populations of Heterodera hordecalis cysts (mean and range)

Character	Skånes Fagerhult population	Tvååker population
Linear (µm)		
Body length (without neck)	563 (395-731)	546 (331-731)
Body width	437 (255-561)	454 (261-623)
Neck length	101 (68-128)	--
Fenestral length	54.5 (47-62)	59.8 (55-68)
Fenestral width	22.2 (17.5-26)	21.7 (18.5-26)
Vulval slit length	20.3 (17-23.5)	20.6 (17-25.5)
Vulval bridge width at surface	27.3 (19-35)	25.4 (17-33)
Vulval bridge width at middle of bridge	17.0 (12.5-24.5)	20.8 (16-27)
Underbridge length	115 (85-143)	121 (89-145)
Underbridge width	26.1 (22-33.5)	30.9 (23-36)
Middle of bridge to middle of underbridge	43.6 (32-53)	44.5 (36-58)
Ratios		
Body length/width	1.29 (1.14-1.57)	1.21 (1.02-1.48)
Fenestral length/width	2.48 (2.00-3.42)	2.77 (2.20-3.30)

Cyst ovoid, pale-medium brown, usually transparent. Neck and vulval cone distinct. Semifenestra widely separated (Fig. 2), usually on slope of vulval cone (Fig. 3A). True width of vulval bridge measured with focus lowered 4-6 µm from surface to

middle of bridge. Cyst underbridge strong with pronounced thickening in middle, ends bifurcate (Figs. 3B-D). Bullae usually absent, few small ones sometimes at level of underbridge (Fig. 3C), numerous in some populations (Andersson, pers. comm.).

(Fig. 2)



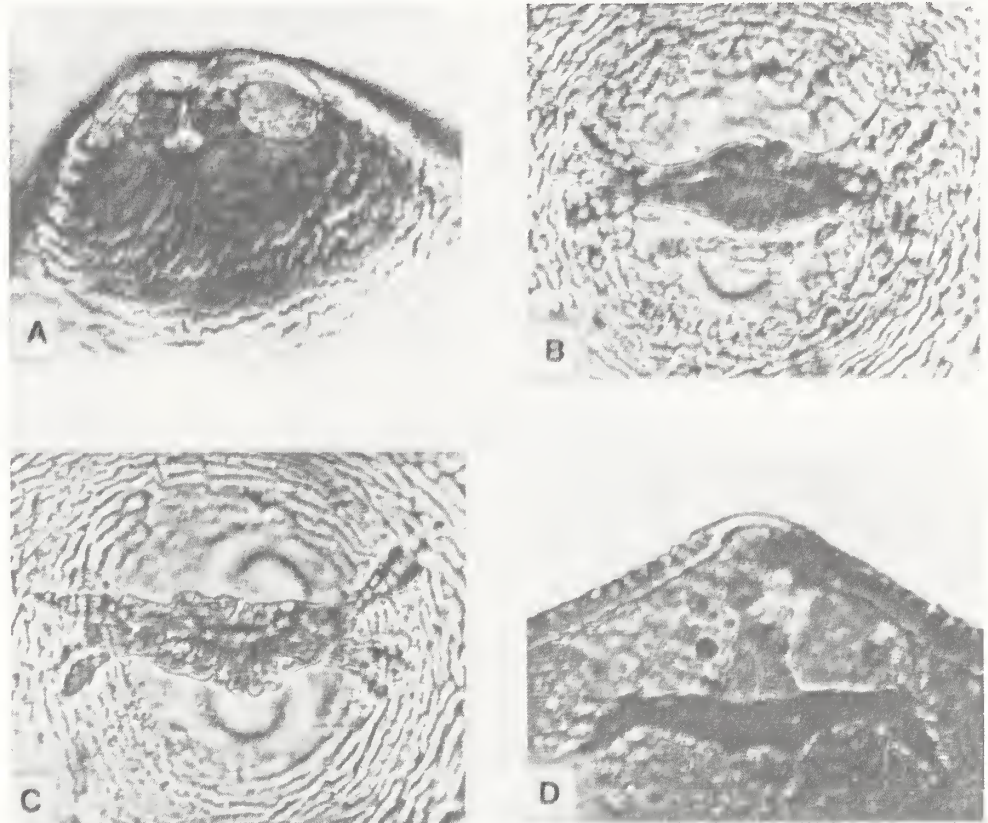
Heterodera hordecalis cyst, end view of vulval cone. A-B. Indistinct semifenestrae, focus: A. at surface, B. about 5 μ m deeper. C-D. Distinct semifenestrae, focus: C. at surface, D. about 5 μ m deeper (From Nematologica, courtesy E. J. Brill).

EGGS - Length = 117.5 (97-131), width = 44.0 (33-51), length/width = 2.68 (2.2-3.1). Egg shell hyaline. Juveniles folded four times, infrequently a partial fifth fold.

MALES - Length = 1112 (805-1390), width = 28.7 (26.5-32.5), a = 38.9 (30-48), b (measured to base of median bulb) = 12.1 (10.1-14.2), stylet length = 26.6 (23.5-28.5), stylet base to dorsal esophageal gland orifice = 4.3 (3.0-6.5), spicules (measured along arc) = 37.2 (33.5-41.5), gubernaculum = 10.5 (9.0-13.0).

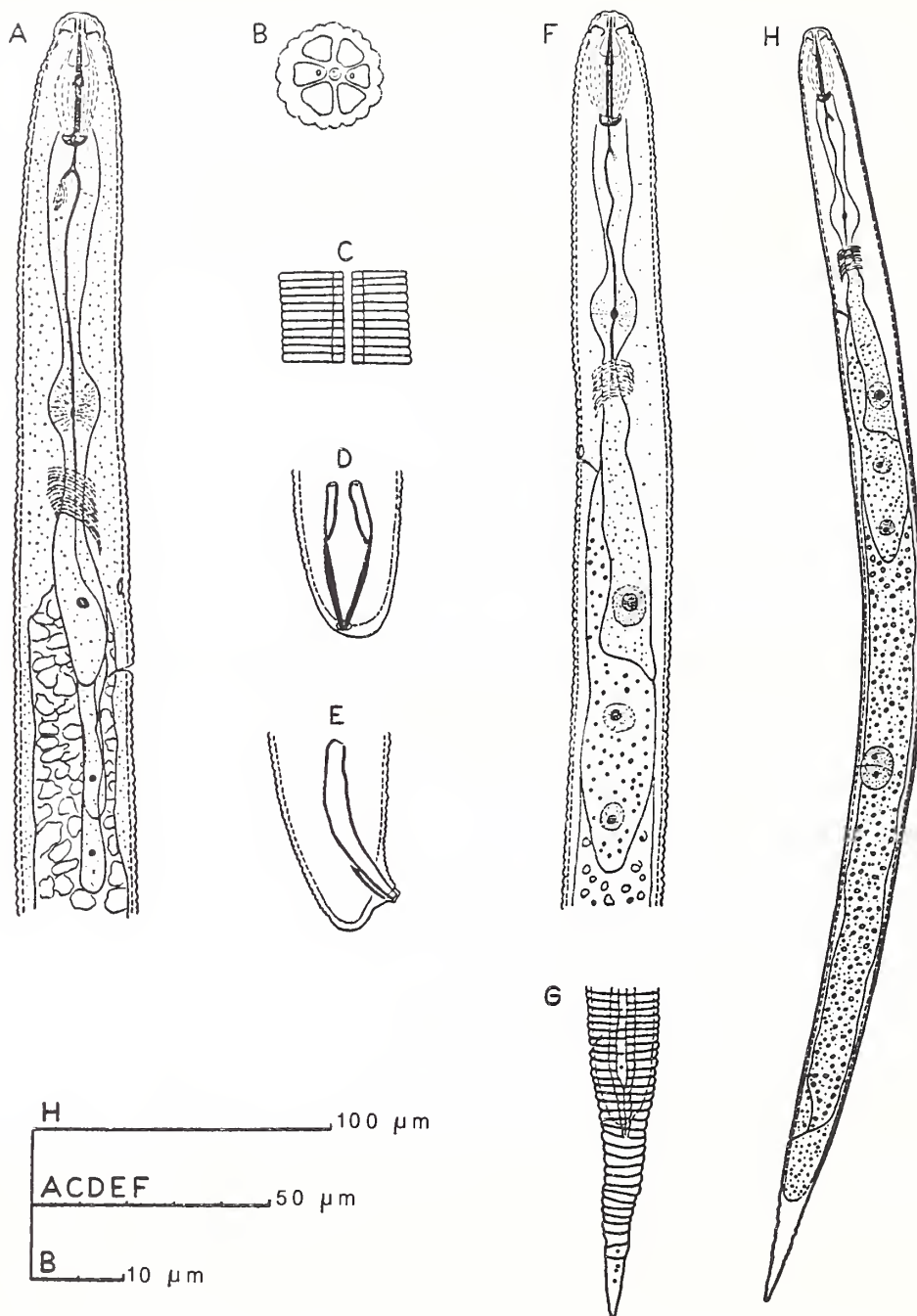
Male head offset with four or five postlabial annules (Fig. 4A), basal annule with longitudinal grooves (Fig. 4B). Stylet knobs well developed, anterior faces slope backward slightly or not at all (Fig. 4A). Hemizonid about two annules wide, usually six to eight annules anterior to excretory pore but may be closer (Fig. 4A). Lateral field with four incisures, outer bands areolated, inner band narrower than outer bands (Fig. 4C). Tail tip smooth (Figs. 4D-E).

(Fig. 3)



Heterodera hordecalis cyst vulval cone. A. Outside view at an angle, showing sloping semifenestrae, long vulval slit, and rigid, dumbbell-shaped bridge. B-C. Inside view. B. Specimen without bullae. C. Specimen with bullae. D. Underbridge and vagina in compressed specimen with ends of underbridge detached, ventral view (From Nematologica, courtesy E. J. Brill).

(Fig. 4)



Heterodera hordecalis. A-E. Male. A. Esophageal region. B. Head, face view. C. Lateral field at midbody. Spicules, D. ventral view, E. lateral view. F-H. Juvenile. F. Esophageal region. G. Tail. H. Entire (From Nematologica, courtesy E. J. Brill).

JUVENILES (Fig. 4H)

Measurements of two populations of Heterodera hordecalis juveniles (mean and range)

Character	Skånes Fagerhult population	Tvååker population
Linear (µm)		
Body length	436 (415-466)	474 (445-512)
Body width	19.3 (18-20.5)	20.3 (19.5-22)
Stylet length	23.4 (21-25)	24.4 (22-26)
Stylet base to dorsal esophageal gland orifice	4.4 (3.5-7.0)	4.7 (3.5-7.0)
Tail length	51.9 (44.5-58.5)	59.7 (53.5-64)
Body width at anus	13.9 (13-15)	14.2 (13-16)
Hyaline tail length	33.6 (29-38.5)	40.0 (35-46.5)
Ratios		
a	22.8 (21.0-25.3)	23.6 (22.0-26.0)
c	8.4 (7.8-9.1)	8.0 (7.5-9.1)
Tail length/body width at anus	3.7 (3.3-4.2)	4.2 (3.6-4.5)
Hyaline tail length/ stylet length	1.4 (1.3-1.7)	1.6 (1.4-1.8)
Body length/hyaline tail length	13.2 (11.6-15.5)	11.9 (10.2-13.4)

Juvenile head slightly offset with three or four head annules (Fig. 4F). Lateral field with four incisures, outer bands completely areolated, inner band to a great extent areolated (Fig. 4G); seen best in temporary water mounts. Stylet knobs strongly forward-pointing (Fig. 4F). Hemizonid immediately anterior to excretory pore (Fig. 4F). Genital primordium at about 60 percent of body length (Fig. 4H). Phasmids two to four annules behind anus (Fig. 4G).

H. hordecalis most closely resembles H. latipons from which it differs by the cyst having a longer vulval slit (17-25.5 µm versus generally 6-9 µm) and a more rigid vulval bridge. Also, second-stage juvenile hyaline tail length/stylet length ratio is 1.3-1.8 for H. hordecalis and 0.8-1.3 for H. latipons.

Characteristic
Damage

Symptoms of damage caused by H. hordecalis are stunting of the plant and yellowing of the leaves. Plants tend to wilt during warmer portions of the day. The symptoms occur in patches, which enlarge as the nematode population increases.

Detection
Notes

H. hordecalis cysts can be carried in soil, even minute amounts, on many different plants and nonplant products entering the United States. It has been intercepted twice since its description.

On imports, collect soil clinging to plant material by cutting off dirty roots or the base of bulbs. When soil is not too apparent, tap or jar off surface dust onto clean paper. Inspection stations can wash plant material over screens without cutting. Be alert for soil on nonplant cargoes.

In the field the most reliable method for detection is the collection of soil samples in a grid pattern and processing by a wet screening method.

For identification, a minimum of 10 cysts with juveniles is desirable. Submitting males and females will help in identifying field infestations.

Biology

H. hordecalis is found mostly in sandy soils. Its life cycle is essentially the same as for other species of Heterodera. Second-stage juveniles hatch from the cyst in the spring and penetrate host roots just behind the root tip. Juveniles feed, molt, enlarge, and become sedentary. They break through the surface of the root, leaving the head and neck embedded. Males that have become wormlike, move through the soil to inseminate females. When the female dies, the cuticle turns brown, the body becoming a cyst filled with embryonated eggs, which develop to the second juvenile stage. The cysts break off from the roots and become free in the soil.

Control

The host range of H. hordecalis is restricted to the Poaceae. While no specific rotations have been recommended, any rotation with a nongrass should reduce nematode populations.

Some cultivars of oats that are poor hosts may be grown. Most wheat cultivars tested are poor hosts. Some cultivars of barley are resistant. There is evidence that there are different nematode races which may complicate the growing of poor or resistant hosts (Andersson 1976, Cook 1982).

Natural
Enemies

No natural enemies have been reported.

Literature
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